PATENT COOPERATION TREATY

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INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference 20400805KC	**FOR FURTHER ACTION** See Form PCT/IPEA/416	
International application No. **PCT/IB2004/002119**	International filing date *(day/month/year)* 21 June 2004	Priority date *(day/month/year)* 26 June 2003
International Patent Classification (IPC) or national classification and IPC **Int. Cl.**[7] G06F 15/18		
Applicant NEURAMATIX SDN. BHD et al		

1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.
2. This REPORT consists of a total of 3 sheets, including this cover sheet.
3. This report is also accompanied by ANNEXES, comprising:
   a. [X] *(sent to the applicant and to the International Bureau)* a total of **14** sheets, as follows:
      - [X] sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).
      - [ ] sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.

   b. [ ] *(sent to the International Bureau only)* a total of (indicate type and number of electronic carrier(s)) , containing a sequence listing and/or table related thereto, in computer readable form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).
4. This report contains indications relating to the following items:
   - [X] Box No. I Basis of the report
   - [ ] Box No. II Priority
   - [ ] Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
   - [ ] Box No. IV. Lack of unity of invention
   - [X] Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
   - [ ] Box No. VI Certain documents cited
   - [ ] Box No. VII Certain defects in the international application
   - [ ] Box No. VIII Certain observations on the international application

Date of submission of the demand 9 December 2004	Date of completion of the report 25 February 2005
Name and mailing address of the IPEA/AU AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA E-mail address: pct@ipaustralia.gov.au Facsimile No. (02) 6285 3929	Authorized Officer **DALE SIVER** Telephone No. (02) 6283 2196

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

International application No.
PCT/IB2004/002119

Box No. I Basis of the report

1. With regard to the **language**, this report is based on the international application in the language in which it was filed, unless otherwise indicated under this item.

   ☐ This report is based on translations from the original language into the following language , which is the language of a translation furnished for the purposes of:

   ☐ international search (under Rules 12.3 and 23.1 (b))

   ☐ publication of the international application (under Rule 12.4)

   ☐ international preliminary examination (under Rules 55.2 and/or 55.3)

2. With regard to the **elements** of the international application, this report is based on (*replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report*):

   ☐ the international application as originally filed/furnished

   ☒ the description:

   pages **1-29** as originally filed/furnished
   pages* received by this Authority on with the letter of
   pages* received by this Authority on with the letter of

   ☒ the claims:

   pages as originally filed/furnished
   pages* as amended (together with any statement) under Article 19

   pages* **30-43** received by this Authority on **9 December 2004** with the demand

   ☒ the drawings:

   Figures 1-11 as originally filed/furnished
   pages* received by this Authority on with the letter of
   pages* received by this Authority on with the letter of

   ☐ a sequence listing and/or any related table(s) - see Supplemental Box Relating to Sequence Listing.

3. ☐ The amendments have resulted in the cancellation of:

   ☐ the description, pages
   ☐ the claims, Nos.
   ☐ the drawings, sheets/figs
   ☐ the sequence listing (*specify*):
   ☐ any table(s) related to the sequence listing (*specify*):

4. ☐ This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).

   ☐ the description, pages
   ☐ the claims, Nos.
   ☐ the drawings, sheets/figs
   ☐ the sequence listing (*specify*):
   ☐ any table(s) related to the sequence listing (*specify*):

* *If item 4 applies, some or all of those sheets may be marked "superseded."*

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

International application No.
PCT/IB2004/002119

Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Claims 1-102	YES
	Claims	NO
Inventive step (IS)	Claims 1-102	YES
	Claims	NO
Industrial applicability (IA)	Claims 1-102	YES
	Claims	NO

2. Citations and explanations (Rule 70.7)

D1 US 6052679 A (APARICIO, IV et al.) 18 April 2000
D2 US 5937432 A (YAMAGUCHI et al.) 10 August 1999
D3 US 5852815 A (THALER) 22 December 1998
D4 WO 1995/000920 A1 (THE UNITED STATES OF AMERICA, represented by the THE SECRETARY, DEPARTMENT OF HEALTH AND HUMAN SERVICES) 5 January 1995
D5 HUMPERT, B. "BIDIRECTIONAL ASSOCIATIVE MEMORY WITH SEVERAL PATTERNS" IJCNN 1990
D6 WANG L. "Multi-associative neural networks and their applications to learning and retrieving complex spatio-temporal sequences" IEEE Transactions on Systems, Man and Cybernetics February 1999

Novelty (N)

D1 discloses a neural network where a plurality of neurons is able to associate (or link) with itself or another neuron. The associations include a Boolean-complete compartment that specify input vectors to the further neurons.

D2 discloses associative storage for learning and recalling. The storage elements can be shown to correspond to neurons of a neural network (eg. Hopfield).

D3 discloses an array of cells (in particular a spreadsheet) where the cells correspond to neurons in a neural network. Thaler explicitly teaches associating neurons for both learning and expression (or recall).

D4 discloses an artificial neural network for temporal processing. The architecture (see Figure 13) provides the ability for a plurality of neurons to associate with each other (or themselves).

None of the citations explicitly disclose using structural neurons and elemental neurons as presently defined in claim 1 (et cetera).

None of the citations explicitly disclose a neural network linked by associations, the neurons being able to be expressed in terms of at least one elemental neuron as presently defined in claim 31 (et cetera).

The claims are novel in light of the above documents.

Inventive step (IS)

The claims all have the inventive concept of learning associations (as described on page 3 lines 16-20) and recalling the pair of neurons that were combined to form a structural neuron (defined as expression see page 3 lines 28-31). These concepts are not considered obvious from the above prior art.

Industrial applicability (IA)

The patent application satisfies PCT requirements for applicability

The Claims:

1. A neural network comprising a plurality of neurons, the plurality of neurons comprising a plurality of elemental neurons and a plurality of structural neurons; all elemental and structural neurons being able to be associated via active connections; all elemental neurons being able to express their elemental values, and all structural neurons being able to express a pair of neurons with which they associate.

2. A neural network as claimed in claim 1, wherein any one of the plurality of neurons is able to associate or link with itself or another neuron in the plurality of neurons via active connections to a further neuron in the plurality of neurons, the further neuron being in a deeper level than both the neuron and the another neuron.

3. A neural network as claimed in claim 2, wherein the neuron and the another neuron are in a level selected from the group consisting of: the same, and different.

4. A neural network as claimed in any one of claims 1 to 3, wherein each elemental neuron is able to be used for both input and output of an elemental value.

5. A neural network as claimed in any one of claims 1 to 4, wherein each structural neuron represents the combined information or memory represented by a pair of neurons, the structural neuron receiving input from the pair of neurons; and each elemental neuron represents at least one selected from the group consisting of: an elemental stimulus, a defined elemental pattern, a defined elemental data element, a basic input stimulus, and an output stimuli of information being processed.

6. A neural network as claimed in any one of claims 1 to 5, wherein associations are at least one selected from the group consisting of: an elemental neuron with an elemental neuron, an elemental neuron with a structural neuron, a structural neuron with an elemental neuron, a structural neuron with a structural neuron.

7. A neural network as claimed in any one of claims 1 to 6, wherein each of the plurality of neurons is one or more selected from the group consisting of: initiating neuron, associated neuron, and associating neuron.

8. A neural network as claimed in claim 7, wherein an initiating neuron is associated with an associated neuron via active connections to the associating neuron.

9. A neural network as claimed in claim 8, wherein the initiating neuron, the associated neuron and the associating neuron are connected based on proximal characteristics, the proximal characteristics being at least one of: temporal, spatial, intensity, magnitude and relative position.

10. A neural network as claimed in any one of claims 1 to 9, wherein structural neurons represent at least one of information and memory; and processing is at least one of: creating structural neurons, and expressing the pair of neurons with which a structural neuron associates.

11. A neural network as claimed in any one of claims 1 to 10, wherein a level of the neural network is a deeper level within the neural network structure if, during expression, more steps are required to express the elemental neurons that it represents.

12. A neural network as claimed in any one of claims 1 to 6, wherein the one of the plurality of neurons is an initiating neuron, the another of the plurality of neurons is an associated neuron, and the further neuron is a associating neuron; the structure being such that when the initiating neuron is activated or fired, the associating neuron is potentiated; and when the associated neuron is

activated or fired, the associating neuron is further potentiated and thus activated and is able to fire.

13. A neural network as claimed in claim 12, wherein the associated neuron is activated or fired at the same time as the initiating neuron.

14. A neural network as claimed in claim 12, wherein the associated neuron is activated or fired after the initiating neuron, with respect to the associating neuron.

15. A neural network as claimed in any one of claims 12 to 14, wherein the activation or firing of the initiating neuron and the associated neuron is based on proximal characteristics.

16. A neural network as claimed in claim 15, wherein the proximal activation or firing of the initiating neuron and the associated neuron causes the creation of new synaptic connections, or the strengthening of existing synaptic connections, between the initiating neuron and the associating neuron and between the associated neuron and the associating neuron.

17. A neural network as claimed in any one of claims 12 to 16, wherein the associating neuron represents the sum of what is learnt from the initiating neuron and the associated neuron; the sum including one or more selected from the group consisting of: a memory trace, a combination of the experience of the initiating neuron and the associated neuron, a memory, and a sequence of events.

18. A neural network as claimed in any one of claims 1 to 17, wherein all elemental neurons are represented in a root level of the neural network.

19. A neural network as claimed in any one of claims 12 to 18, wherein once the associating neuron is activated to represent a desired result, the desired result need not be recreated in another neuron.

20. A neural network as claimed in claim 10, wherein creating a structural neuron is learning, and expressing the pair of neurons is expression.

21. A neural network comprising a plurality of elemental neurons, and a plurality of structural neurons for representing associations between any pair of neurons, the pair of neurons being selected from the group consisting of: both elemental neurons, both structural neurons, one structural and one elemental neuron, and one elemental neuron and one structural neuron.

22. A neural network as claimed in claim 21, wherein the plurality of elemental neurons are represented in a root level of the neural network, and each elemental neuron represents at least one of: an elemental stimulus, a defined pattern and a defined data element; each elemental stimulus being for representing at least one of: a basic input stimuli and an output stimuli of information being processed.

23. A neural network as claimed in claim 21 or claim 22, wherein each elemental neuron is selected from the group consisting of: a sensor neuron and a motor neuron.

24. A neural network as claimed in claim 22, wherein the information being processed is memory.

25. A neural network as claimed in any one of claims 22 to 24, wherein the processing is at least one of: learning and expression.

26. A neural network as claimed in any one of claims 21 to 25, wherein the plurality of neuron associations are represented in a plurality of deeper neural levels.

27. A neural network as claimed in claim 26, wherein the number of levels in the plurality of deeper levels is determined by the extent of the memory or pattern to be processed or expressed, where memory represents a plurality of elemental neurons.

28. A neural network as claimed in claim 27, wherein the number of elemental neurons and structural neurons required to represent the memory is determined by a nature of the memory to be processed.

29. A neural network as claimed in any one of claims 21 to 28, wherein any one of the plurality of structural neurons is able to associate with another structural neuron in the plurality of neurons via active connections to a further structural neuron in the plurality of structural neurons.

30. A neural network as claimed in claim 29, where the further structural neuron is in a deeper level than both the structural neuron and the another structural neuron.

31. A neural network comprising a plurality of neurons linked by associations, all of the plurality of neurons being able to be expressed in terms of at least one elemental neuron from which they were derived or represent.

32. A neural network as claimed in claim 31, wherein the plurality of neurons comprises a plurality of elemental neurons and a plurality of structural neurons; all elemental neurons being able to express their elemental values, and all structural neurons being able to express a pair of neurons with which they associate.

33. A neural network comprising plurality of neurons, each of the plurality of neurons being represented by a unique addressable node in an array, each of the plurality of neurons being linked by associations, and all of the plurality of neurons are able to be expressed.

34. A neural network as claimed in claim 33, wherein the plurality of neurons comprises a plurality of elemental neurons and a plurality of structural neurons; all elemental neurons being able to express their elemental values, and all structural neurons are able to express a pair of neurons with which they associate.

35. A neural network as claimed in claim 33 or claim 34, where each neuron is represented in its entirety by a single node in the array.

36. A neural network comprising a plurality of nodes in an array, each node comprising at least one pointer, each pointer being a data element of the node; each data element representing a unique address of a specific node in the array, and each address represents a neuron of a plurality of neurons; and each of the plurality of neurons is linked by associations, all neurons being able to be expressed.

37. A neural network as claimed in claim 36, wherein the plurality of neurons includes a plurality of elemental neurons and a plurality of structural neurons; all elemental neurons being able to express their elemental values, and all structural neurons being able to express a pair of neurons with which they associate.

38. A neural network as claimed in claim 36 or claim 37, wherein each of the plurality of neurons is represented by an addressable node in an array.

39. A neural network comprising a plurality of neurons, each neuron being stored as a unique node of an addressable array, and each address of each node in the array uniquely represents that neuron.

40. A neural network comprising a plurality of neurons represented by an array, every neuron in the array having pointers for providing expression, each neuron being represented by a node in the array, each node having a plurality of pointers.

41. A neural network as claimed in claim 40, wherein each pointer in each node contains at least one of: an address of another neuron, and an elemental value for an elemental neuron.

42. A neural network as claimed in claim 40 or claim 41, wherein each pointer has a specific and unique function and represents a synaptic connection.

43. A neural network as claimed in claim 41 or claim 42 when appended to claim 41, wherein the plurality of neurons includes a plurality of elemental neurons and a plurality of structural neurons; all elemental neurons being able to express their elemental values, and all structural neurons being able to express a pair of neurons with which they associate.

44. A neural network as claimed in claim 43, wherein except where the pointer represents the value of an elemental stimulus in the elemental neurons, each pointer containing an address of another neuron.

45. A neural network as claimed in any one of claims 40 to 44, wherein the number of pointers depends on a function being performed by the neural network.

46. A neural network as claimed in any one of claims 40 to 45, wherein the number of pointers for each neuron is at least two.

47. A neural network as claimed in any one of claims 40 to 46, wherein a function of each pointer to a neuron is selected from the group consisting of: initiating, associating, successor, next successor of the initiating neuron, precessor, and next precessor of the associating neuron.

48. A neural network as claimed in claims 43, wherein each pointer for an elemental neuron represents elemental values.

49. A neural network as claimed in any one of claims 1 to 48, wherein all neurons are of a fixed length.

50. A neuronal assembly for use in a neural network, the neuronal assembly comprising an initiating neuron, an associated neuron, and a associating

neuron operatively connected to the initiating neuron and the associated neuron.

51. A neural assembly as claimed in claim 50, wherein when the initiating neuron is activated or fired, the associating neuron is potentiated; and when the associated neuron is activated or fires, the associating neuron is potentiated and activated and able to fire.

52. A neural assembly as claimed in claim 51, wherein the associated neuron is fired at the same time as the initiating neuron.

53. A neural assembly as claimed in claim 51, wherein the associated neuron is fired after the initiating neuron.

54. A neural assembly as claimed in any one of claims 50 to 53, wherein the activation or firing of the initiating neuron and the associated neuron is based on proximal characteristics.

55. A neural assembly as claimed in claim 54, wherein the proximal activation or firing of the initiating neuron and the associated neuron causes the creation of new synaptic connections, or the strengthening of existing synaptic connections, between the initiating neuron and the associating neuron and between the associated neuron and the associating neuron.

56. A neural assembly as claimed in any one of claims 50 to 55, wherein the associating neuron represents the sum of what is learnt from the initiating neuron and the associated neuron.

57. A neural assembly as claimed in claim 56, wherein the sum includes one or more selected from the group consisting of: a memory trace, a combination of the experience of the initiating neuron and the associated neuron, a memory, and a sequence of events.

58. A neural assembly as claimed in any one of claims 50 to 57, wherein once the associating neuron is activated to represent a desired result, the desired result need not be recreated in another neuron.

59. A method for creating an association of neurons in a neural network, the neural network having a plurality of neurons, one of the plurality of neurons being an initiating neuron, another of the plurality of neurons being an associated neuron, and a further neuron of the plurality of neurons being a associating neuron; the method comprising:

(a) activating or firing the initiating neuron to potentiate the associating neuron; and

(b) activating or firing the associated neuron to potentiate and activate the associating neuron, the associating neuron then being activated and able to fire.

60. A method as claimed in claim 59, wherein the associated neuron is activated or fired at the same time as the initiating neuron.

61. A method as claimed in claim 59, wherein the associated neuron is activated or fired after the initiating neuron.

62. A method as claimed in any one of claims 59 to 61, wherein the activation or firing of the initiating neuron and the activation or firing of the associated neuron is based on proximal characteristics.

63. A method as claimed in claim 62, wherein the proximal activation or firing of the initiating neuron and the associated neuron causes the creation of new synaptic connections, or the strengthening of existing synaptic connections, between the initiating neuron and the associating neuron and between the associated neuron and the associating neuron.

64. A method as claimed in any one of claims 59 to 63, wherein the associating neuron represents the sum of what is learnt from the initiating neuron and the associated neuron.

65. A method as claimed in claim 64, wherein the sum includes one or more selected from the group consisting of: a memory trace, a combination of the experience of the initiating neuron and the associated neuron, a memory, and a sequence of events.

66. A method as claimed in any one of claims 59 to 65, wherein once the associating neuron is activated to represent a desired result, the desired result need not be recreated in another neuron.

67. A method of operating a neural network having a plurality of neurons including a plurality of elemental neurons and a plurality of structural neurons, the method comprising:

(a) defining events the elemental neurons and structural neurons will represent;

(b) creating a required number of elemental neurons for the total number of unique values to be represented for all defined events; and

(c) creating a set of rules for association of the plurality of neurons.

68. A method as claimed in claim 67, wherein any one of the plurality of neurons is able to associate with another neuron in the plurality of neurons via active connections to a further neuron in the plurality of neurons.

69. A method as claimed in claim 68, where the further neuron is in a deeper level than both the neuron and the another neuron.

70. A method as claimed in claim 68 or claim 69, wherein the neuron and the another neuron are in the same level.

71. A method as claimed in claim 68 or claim 69, wherein the neuron and the another neuron are on different levels.

72. A method as claimed in any one of claims 67 to 71, wherein all elemental neurons are able to express their elemental values, and all structural neurons are able to express a pair of neurons with which they associate.

73. A method as claimed in claim 72, wherein associations are one or more selected from the group consisting of: an elemental neuron with an elemental neuron, an elemental neuron with a structural neuron, a structural neuron with an elemental neuron, a structural neuron with a structural neuron.

74. A method as claimed in any one of claims 67 to 73, wherein each of the plurality of neurons is one or more selected from the group consisting of: initiating neuron, associating neuron, and associating neuron.

75. A method as claimed in claim 74, wherein an initiating neuron is associated with an associated neuron via active connections to the associating neuron.

76. A method as claimed in claim 75, wherein the initiating neuron, the associated neuron and the associating neuron are connected based on proximal characteristics.

77. A method as claimed in claim 76, wherein the proximal characteristics are at least one of: temporal, spatial, intensity, magnitude and relative position.

78. A method as claimed in any one of claims 69 to 77, wherein a level of the neural network is a deeper level within the neural network structure if, during recollection, more steps are required to express the elemental neurons.

79. A method as claimed in any one of claims 74 to 77, further comprising:

(a) activating or firing the initiating neuron potentiates the associating neuron; and

(b) activating or firing the associated neuron potentiates and activates the associating neuron, the associating neuron then being activated and able to fire.

80. A method as claimed in claim 79, wherein the associated neuron is activated or fired at the same time as the initiating neuron.

81. A method as claimed in claim 79, wherein the associated neuron is activated or fired after the initiating neuron.

82. A method as claimed in any one of claims 79 to 81, wherein the activation or firing of the initiating neuron and the activation or firing of the associated neuron is based on proximal characteristics.

83. A method as claimed in claim 82, wherein the proximal activation or firing of the initiating neuron and the associated neuron causes the creation of new synaptic connections, or the strengthening of existing synaptic connections, between the initiating neuron and the associating neuron and between the associated neuron and the associating neuron.

84. A method as claimed in any one of claims 79 to 83, wherein the associating neuron represents the sum of what is learnt from the initiating neuron and the associated neuron.

85. A method as claimed in claim 84, wherein the sum includes one or more selected from the group consisting of: a memory trace, a combination of the experience of the initiating neuron and the associated neuron, a memory, and a sequence of events.

86. A method as claimed in any one of claims 69 to 85, wherein the plurality of elemental neurons are represented in a root level of the neural network, and each elemental neuron responds to an elemental stimulus or pattern, each elemental stimulus being for representing one of: a basic input stimuli and an output stimuli of information being processed.

87. A method as claimed in claim 86, wherein the information is memory.

88. A method as claimed in claim 86 or claim 87, wherein the processing is expression.

89. A method as claimed in any one of claims 86 to 88, wherein the plurality of structural neurons are represented in a plurality of deeper neural levels.

90. A method as claimed in claim 89, wherein the number of levels in the plurality of deeper levels is determined by the extent of the memory or pattern to be processed or expressed, where a memory represents a plurality of elemental stimuli, and each elemental stimulus is represented directly by an elemental neuron.

91. A method as claimed in claim 90, wherein the number of elemental neurons required to represent the memory is determined by a nature of the memory to be processed.

92. A method as claimed in any one of claims 67 to 91, wherein each neuron is represented in its entirety by a single node in an array.

93. A method as claimed in any one of claims 67 to 91, wherein each of the plurality of neurons is in an array, the array having pointers for providing expression

94. A method as claimed in claim 93, wherein each neuron is represented by a node in the array, each node having a plurality of pointers, each pointer in each node containing an exclusive address of another neuron.

95. A method as claimed in any one of claims 67 to 94, wherein all neurons are of a fixed length.

96. A computer usable medium comprising a computer program code configured to cause one or more processors to execute one or more functions to perform the method claimed in claims 67 to 95.

97. A neural network as claimed in any one of claims 1 to 49, wherein the neural network is bi-directional.

98. A neural network wherein the neural network is bi-directional and is enabled to operate in a forward mode where structural neurons are derived from input events, and in a reverse mode where input events are derived from structural neurons.

99. A neural network as claimed in claim 98, wherein the forward mode is learning, and the reverse direction is expression.

100. A neural network as claimed in any one of claims 1 to 49, or 97 to 99, wherein the neural network stores associations and not data.

101. A neural network as claimed in claim 100, wherein the neural network recognises patterns within patterns of associations.

102. A neural network as claimed in claim 100 or claim 101, wherein the neural network is used for one or more of: monitoring and predicting stock price movements, Internet surveillance, Internet security, computer virus detection, computer spam detection, phrases in speech and text, clauses in speech and text, plagiarism detection, bioinformatics, vision recognition, semantic analysis, representation of data ontologies, robotics, and data compression.

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Your Ref: 20400805KC

Re: International Preliminary Examination Report on Application No. PCT/IB2004/002119 in the name of NEURAMATIX SDN. BHD et al

Dear Madam/Sir

Please find attached a copy of the International Preliminary Examination Report on your application.

I apologise for any inconvenience resulting from this Report not issuing within the time set out in our Customer Service Charter.

Yours faithfully

DALE E. SIVER
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